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The heavy metals in water of select Spitsbergen and Iceland glaciers

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In the summer time, as a result of ice melting, which takes part inside of the glaciers, melted water often floats down. It floats trough subglacier tunnels, as supraglacier streams and in coast areas of glacier. Melted water is usually poorly mineralized. However it contains some substances which composition and concentration is various according to the localization of the glacier (Jóźwiak, Kozłowski 2005). The chemical composition of glacier water is formed by the chemicals from snow, chemical composition of air contamination, in wet and dry form, including sea aerosols, chemical composition of rainwater, chemical composition of water which flows from outside of the glacier and chemical reaction inside the glacier area (Jania 1997). One of the component in supraglacier water are heavy metals. Their source are dusts placed in snow which come from Europe (Pacyna et al. 1985), especially from North Europe (Paatero et al. 1993) and industrial areas of Siberia (Mielnikov 1991). The pollution transport, including heavy metals, takes place also in Arctic Sea area (Pfirman et al. 1995). On Iceland, the source of heavy metals in water, which flows over the glacier are also volcanic dusts.

The purpose of this article is to present the content of heavy metals in supraglacier water streams of the selected glaciers of Svalbard and Iceland.

In july 2003 was taken water samples from one of the glaciers of Spitsbergen. The chosen glaciers were: Waldemar (NW Spitsbergen), Ebba (Middle Spitsbergen) and Hans (South Spitsbergen). On Iceland the glaciers which were chosen to examine were placed in south Solhejmajökull and south-west Fláajölull part of the Iceland, from where the water samples were taken in August 2005 (Fig. 1, 2). One liter of water was taken into the BRAND containers and transported in temperature of 4°C to Poland to

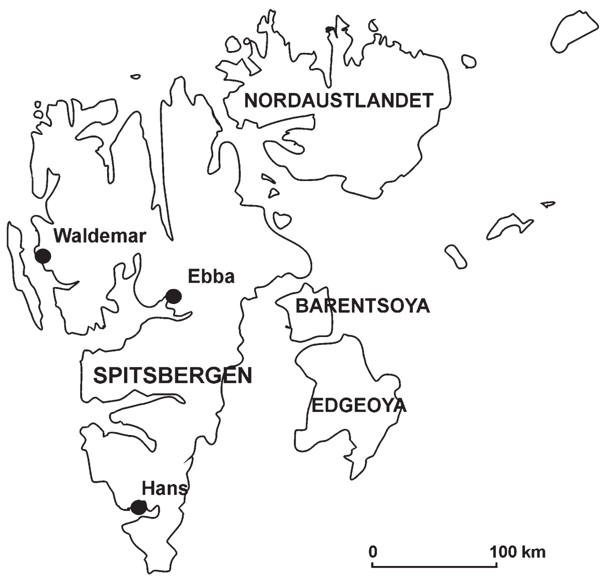

Fig. 1. Spitsbergen glaciers localizations

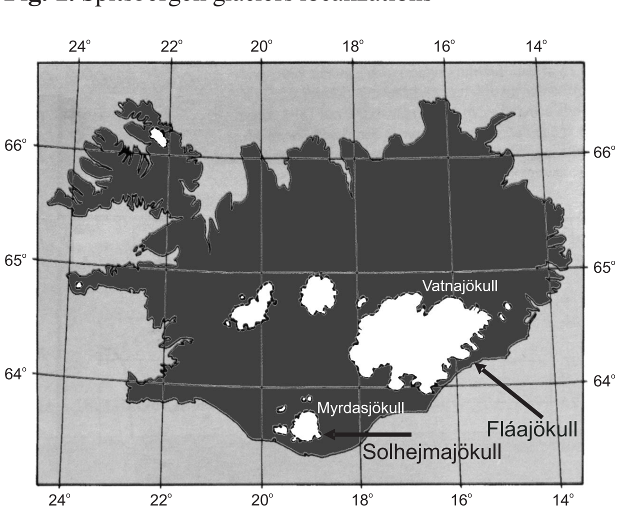

Fig. 2. Island glaciers localizations

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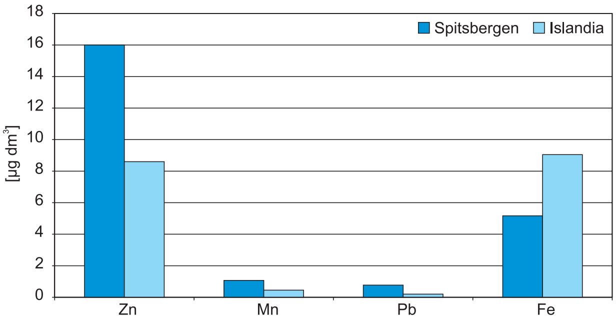

Fig. 3. Participate heavy metals in the water of supraglacial streams Spitsbergen and Iceland glaciers

Laboratory of Province Inspector Environmental Protection in Kielce (the certificate of Polish Center of Research and Certification AB 106) and in Laboratory Environmental Monitoring Institute Environmental Protection in Warsaw (the certificate of Polish Accreditation Center AB 337) where was defined content of zinc, lead, manganese and iron according to the norm adequate to each analyze.

The Waldemar glacier lays on the north-west Spitsbergen in Kaffiøyry region (78°33' ÷ 78°44'N and 11°43' ÷12°13'E). It is the valley glacier, alpine type, area 2,68 km^2 (Sobota 2003), It lays between 130 m a.s.l. and 490 m a.s.l. and consists of two parts (2,25 km^2, 0,43 km^2) separated by the middle moraine. The main, north part gradually falls into south-west and its surface is quite flat, with poorly marked faults on the sly surface (Lankauf 2002). The supraglacier rivers on the front are numerous but shallow.

The Ebba glacier is edging-valley (Rachlewicz 2003). It lays on middle Spitzbergen in Petuniabukta region (78°40' ÷ 78°50'N and 11°43' ÷ 12°13'E). It lays between 700 m a.s.l. and 1000 m a.s.l. The area was set on 25 km^2 (Hagen et al. 1993).

The Hans glacier – area 58,4 km^2 – lays in south part of Wedela Jarslberga Land (77º05'N and 15º38'E) on 500 m a.s.l. Its' length is 16 km, average surface slope under 2^o. It has meridian cost and goes into Hornsund fiord as a glacier cliff (Jania et al. 2003).

The Solhejmajökull is one of the edging glacier in south part of Mýrdalsjökull, in area of 596 km^2 and lays on vollcano-mountain massif over 1200 m a.s.l. high (Karasiewicz 2005). The face is on 110 m a.s.l. The length of tongue is about 15 km, and its area is about 45 km^2 (Sigurdsson 1998). The width of the glacier is about 2 km in the middle and it narrows into 1 km in the south part (Eiriksson et al. 1994). The capacity of ice in the glacier is estimated on about 12,3 km^3 and its thickness is 268 m average. Under the glacier is caldera of the volcanic Kalt system. The whole area lays on the south-east part of icelandic neovolcanic-ryft and that is why the earth-quakes and subice volcanic eruption are often there (Einarsson, Brandsdóttir, 2000).

The Fláajökull is the edging glacier of Vatnajökull and it lays in south-east Iceland. The length of the glacier is 15 km, and the average width is 2,5 km (Dąbski et al. 1998).

The researches show the differences in participation of marked heavy metals in supraglacier water between examined glaciers of Spitsbergen and Iceland. On Spitsbergen, except the iron, dominated all analyzed metals (ryc. 3). The concentration of zinc was about 46,3% higher, with average for tree glaciers 16,00 μg dm^{-3} , manganese 57,9% higher, with average 1,07 μg dm^{-3} and lead 74% with average 0,77 μg dm^{-3}.

On Iceland, iron has dominated in water of the examined glaciers with average 9,05 μg dm^{-3} and it was about 42,9% higher than average for the glaciers of Spitsbergen.

The analyze of the content of heavy metals in water floating from Spitsbergen glaciers shows, that the amount of heavy metals decreases from the south (Hans glacier) to north (Waldemar glacier). That confirms the results of Pacyna's (and others 1985) and Paatero's (and others 2003) researches about the sources of heavy metals on Svalbard.

On Iceland, the higher contet on heavy metals in water on glacier was marked on south-east part of the Iceland. In this case the sources of heavy metals should be recognized in local conditioning.

Literature

Dąbski, M., Fabiszewski, B., Pękalska, A., 1998. Marginal zone of Fláajökull (Iceland). Initial result of research. Miscellanea Geographica 8: 47–54.

Einarsson, P., Brandsdóttir, B., 2000. Earthquakes in the Mýrdalsjökull area, Iceland, 1978–1985: Seasonal corelation and connection with volcanoes. Jökull 49: 59–73.

Eiriksson, J., Larsen, G., Björnsson, H., Simonarson, L. A., Hallsdóttir, M., 1994. Roadlog Nordic Geological Excursion in Iceland. Quaternary geology – glaciology, Excursion day 11, Reykjavik: 95–100.

Hagen, J.O., Liestøl, O., Rolad, E., Jørgensen, T., 1993: Glacier atlas of Svalbard and Jan Mayen. Norsk Polarinstitutt Meddeleser 129: 1–141.

Jania, J., 1997. Glacjologia, PWN, Warszawa.

Jania, J., Głowacki, P., Kolendra, L., Perski, Z., Piwowar, B., Pulina, M., Szfraniec, J., Bukowska-Jania, E., Dobiński, W., 2003. Lodowce otoczenia Hornsundu, In: Funkcjonowanie dawnych i współczesnych geoekosystemów Spitsbergenu, A. Kostrzewski, Zb. Zwoliński (eds.), Warsztaty Geomorfologiczne Spitsbergen SGP, Poznań–Longyearbyen: 94–117.

Jóźwiak, M., Kozłowski, R., 2004. Fizykochemiczne i chemiczne właściwości wód potoków supragla-

cjalnych lodowców Ebba (Środkowy Spitsbergen) i Waldemara (NW Spitsbergen), Polish Polar Studies, PAN, Warszawa: 143–148.
Karasiewicz, M.T., 2005. Dynamika Sólheimajökull i zjawiska wielkich powodzi lodowcowych (jökulhlaups) na jego przedpolu, Przewodnik terenowych warsztatów geomorfologicznych, Islandia 2005: 57–62.
Lankauf, K.R., 2002. Recesja lodowców rejonu Kaffiøyry (Ziemia Oskara II – Spitsbergen) w XX wieku. Prace Geograficzne IGiPZ, PAN, Warszawa: 183 pp.
Melnikov, S.A., 1991. Raport on heavy metals, State of the Arctic Environment Raports. Arctic Centre, University of Lapland, 2: 82–153.
Paatero, J., Hatakka, J., Holmen, K., Eneroth, K., Viisanene, Y., 2003. Lead-210 concentration in the air at Mt. Zeppelin, Ny Ålesund, Svalbard. Physics and Chemistry of the Earth, 28: 1175–1180.
Pacyna, J.M., Ottar, B., Tomza, U., Maaenhant, W., 1985. Long-range transport of trace elements to Ny Ålesund, Spitsbergen. Atmos. Environ., 19: 857–865.
Pfirman, S.L., Eiken, H., Bach, D., Weeks, W.F., 1995. The potencial transport of pollutants by Arctic sea ice. The Science of the Total Environment, 159: 129–146.
Rachlewicz, G., 2003. Charakterystyka i procesy glacjalne lodowca Ebba. In: Funkcjonowanie dawnych i współczesnych geoekosystemów Spitsbergenu, A. Kostrzewski, Zb. Zwoliński (eds.), Warsztaty Geomorfologiczne Spitsbergen SGP, Poznań-Longyearbyen: 43–46.
Sigurdsson, O., 1998. Glacier variations in Iceland 1930–1995. From the database of the Iceland Glaciological Society. Jökull 45(3).
Sobota, I., 2003. Bilans masy lodowca Waldemara i lodowca Ireny (północno-zachodni Spitsbergen) w 2002 roku, Mat. XXIX Międzynarodowego Sympozjum Polarnego Funkcjonowanie ekosystemów polarnych na tle globalnych zmian środowiska, Kraków 19–21.09.2003 r.: 251–253.